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International Symposium on Astronomical Telescopes and Instrumentation
Session on Radio Telescopes
Chair: Harvey R. Butcher

Abstract Title: Design and Performance Predictions of an all Composite Primary Mirror for the FIRST Mission

Authors: Steven, J. Connell, COI; Javier Escobedo-Torres, COI; Zvi Friedman, COI; Anthony Tam, COI; Eri J. Cohen, JPL
Please address all correspondence to Steven Connell, Composite Optics, Inc., 9617 Distribution Avenue, San Diego, CA, 92121. Telephone (619) 621-6942, fax (619) 621-5770, sconnell@coi-world.com

Presentation: Oral Presentation

Abstract: The design and analysis an all composite primary mirror for the FIRST ESA mission is presented. The results of trade studies used to arrive at the current configuration are also discussed. Composite materials are an ideal choice for the FIRST Telescope Primary Mirror, since they provide dimensional stability, excellent stiffness to weight ratios, near zero thermal expansion, and manufacturing flexibility. The selected configuration of the primary mirror must satisfy requirements such as surface figure requirements at operating temperatures of 80K as well as stiffness and strength considerations during launch.

The design developed for the primary mirror balances considerations of performance, producibility and cost. The analysis predictions presented in this study demonstrate the feasibility of the all composite design developed for the primary mirror for the ESA FIRST mission.

The design of the all composite primary mirror is a sandwich construction with the front and back face-sheets separated by an egg-crate core structure. The front and back face-sheets are each comprised of six petals, or laminates, a feature that greatly simplifies the manufacturing process. In addition, it allows for optimizing the location of each petal, based upon its tested material properties, to improve the overall performance of the mirror. Although the face-sheets are discontinuous due to the gaps between the petals, the core structure is bonded to the face-sheets in an arrangement that makes the mirror act as a monolithic structure. Invar fittings are embedded in the core structure, and are used to connect the primary mirror to its support structure via flexures.